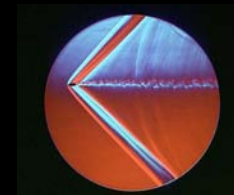
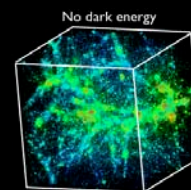
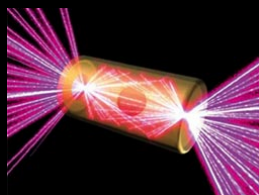
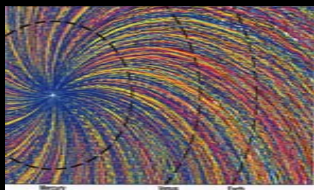




Innovation for our nation



Laboratory Directed Research and Development: Why We Do It

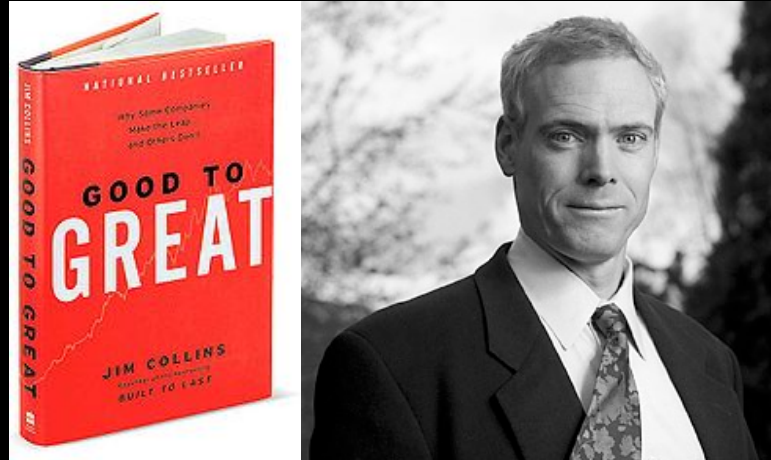
Dr. William Priedhorsky

LDRD Program Director

8 September 2010

Prerequisites for Excellence, according to “Good to Great”

- For excellence, focus on something:
 - That is economically critical
 - That draws one’s passion
 - At which you are world class

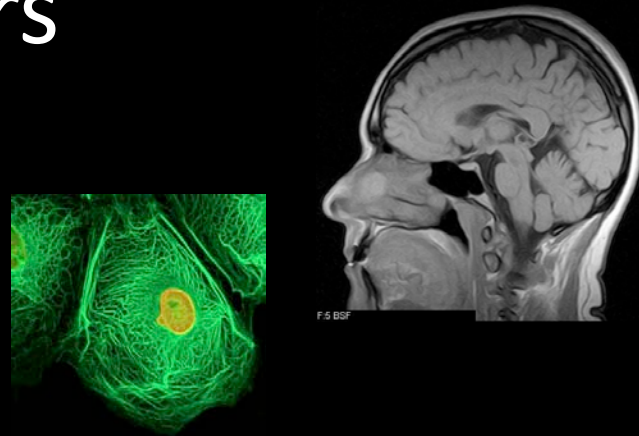


Answer 1: R&D is Strategically and Economically Critical

- “A large empirical literature reports estimates of the rate of return to R&D ranging from 30% to over 100%”, Jones & Williams 1998
- “Recent studies have estimated that the average annual rate of return on R&D investment ranges from 28% to 50%, depending on the assumptions used”, J. Friedman 2002
- Technical change is the primary factor behind economic growth, Robert Solow, Nobel Prize 1987 economics

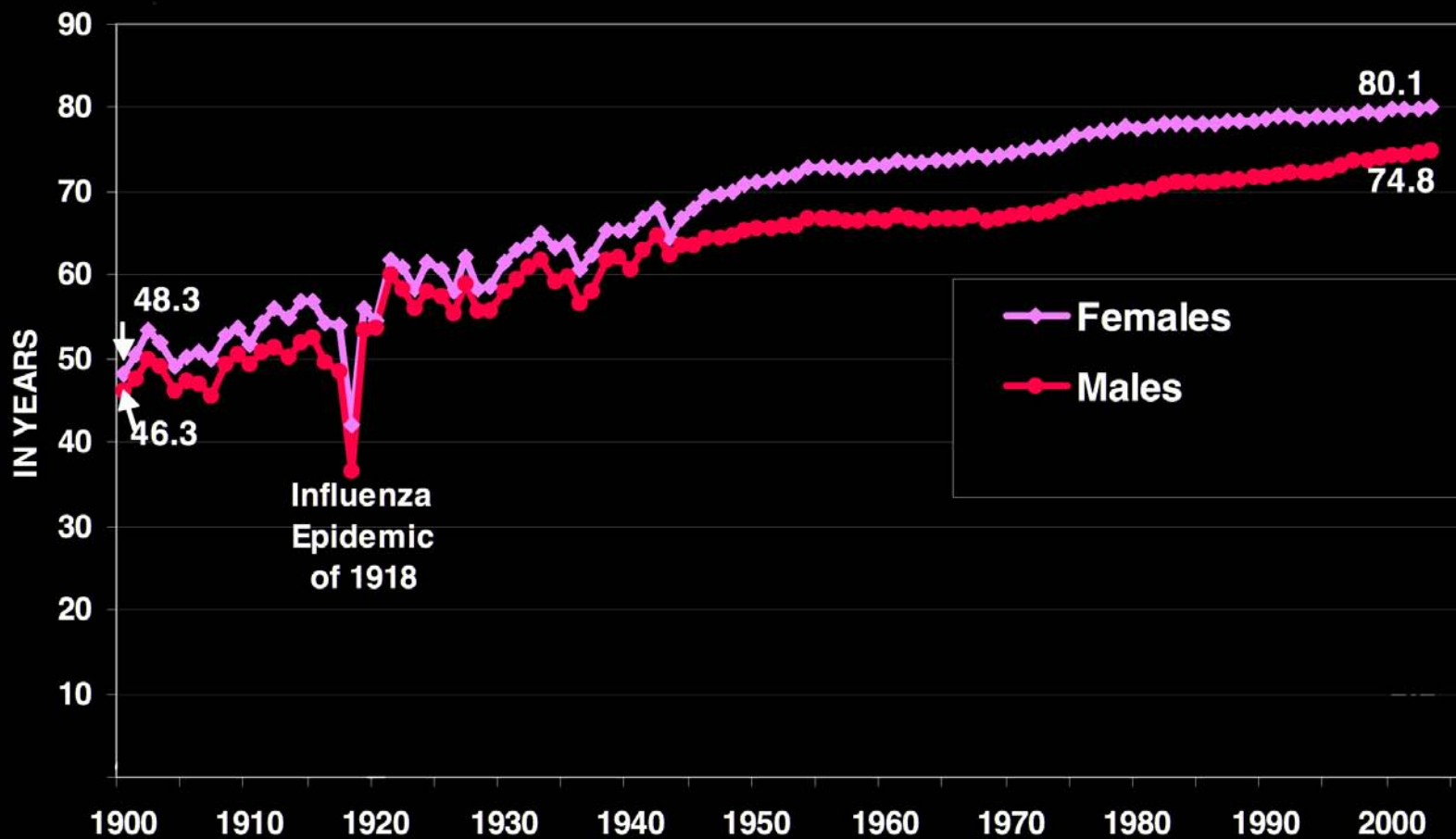
Some of the benefits of R&D over the last 50 years

- Research in nuclear, high energy and condensed matter physics has led to remarkable tools for the non-invasive diagnosis and treatment of disease, including :
 - PET scans
 - MRIs
 - Nuclear medicine and cancer therapies
- Quantum mechanics, the theory developed to explain the structure of the atom, underlies some of our most important technologies, including:
 - Computers
 - Lasers
 - Consumer electronics
 - Telecommunications
 - Atomic clocks
 - Superconductors
- The World Wide Web was originally developed to enable physicists worldwide to collaborate and share data



A big benefit of R&D

Figure 1. Life Expectancy at Birth, by Sex: 1900 to 2003.

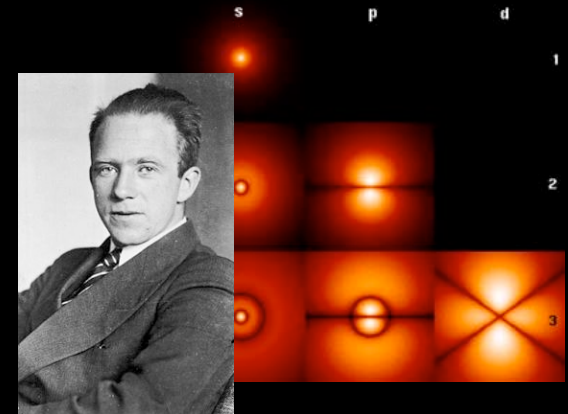


R&D Takes Patience:

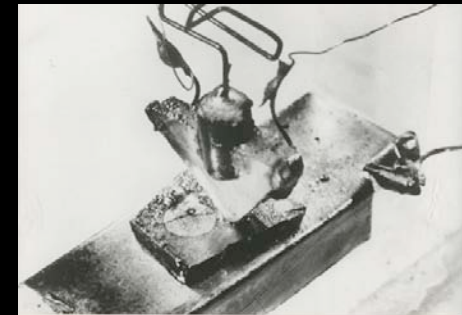
The path to the computer revolution

- In 1885, Johann Balmer discovered his **formula for the spectral lines of the hydrogen atom**; the Lyman, Pfund, Brackett, and Paschen spectral series followed.
- In 1900, Max Planck proposed the concept of the quantum in the emission of energy; and in 1905, Albert Einstein developed the idea of the **quantum of energy in the radiation field (the photon)**.
- In 1925 and 1926, Werner Heisenberg and Erwin Schrödinger developed **quantum mechanics**.
- In 1928, Felix Bloch applied the full machinery of quantum mechanics to the problem of conduction in solids, spearheading the **development of the modern theory of solids**.
- In 1947, John Bardeen and Walter Brattain took out a patent for **the transistor**, and William Shockley applied for a patent for the **transistor effect and a transistor amplifier**.
- In 1959, Robert Noyce and Jack Kilby invented the **integrated circuit**.

Jerome I. Friedman, Industrial Physicist 2002



Werner Heisenberg



First transistor

R&D Challenges for Los Alamos Missions

A vertical panel with a background image of a nuclear missile launching from a silo, with a large plume of fire and smoke trailing behind it.

Nuclear Deterrence

Predicting the performance of complex systems from first principles

A vertical panel with a background image of a satellite in orbit above Earth, with solar panels extended and a view of the planet's horizon.

Global Threat Reduction

Understanding everything important, in all places and at all times

A vertical panel with a background image of a wind turbine and a field of solar panels under a clear sky.

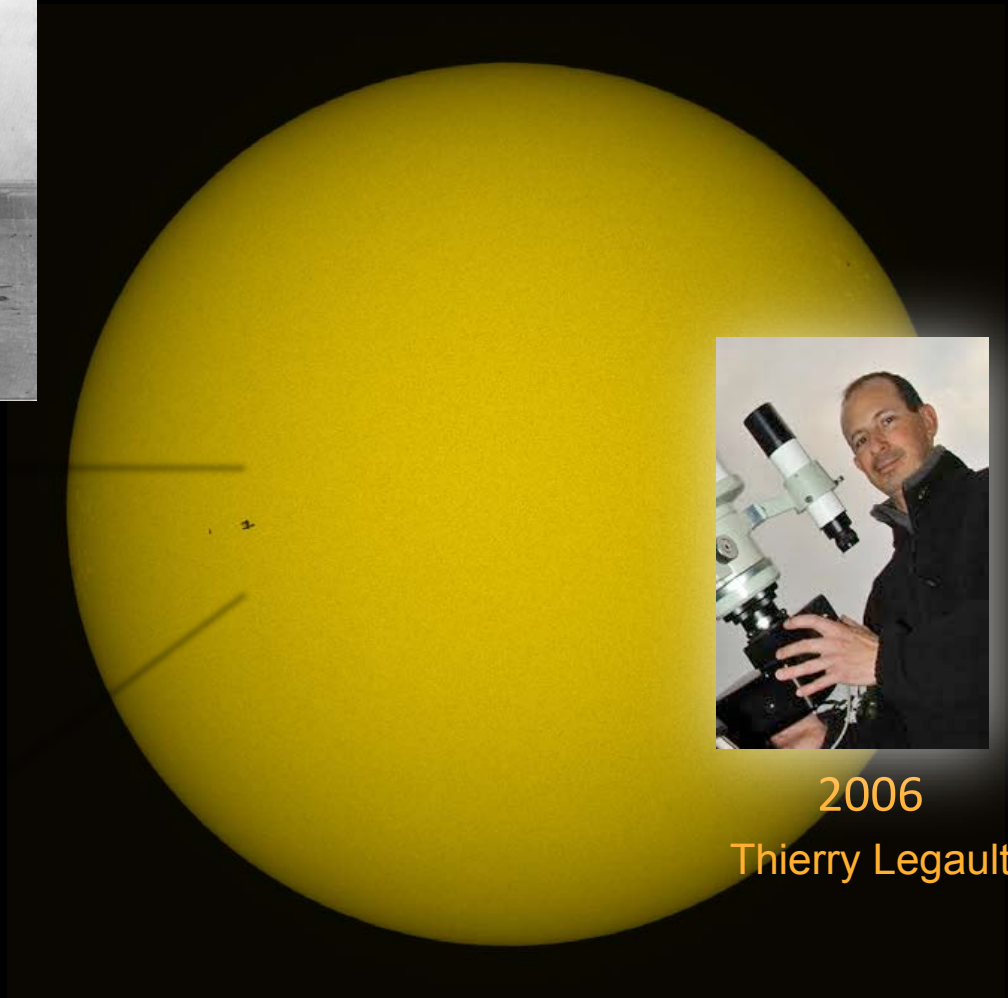
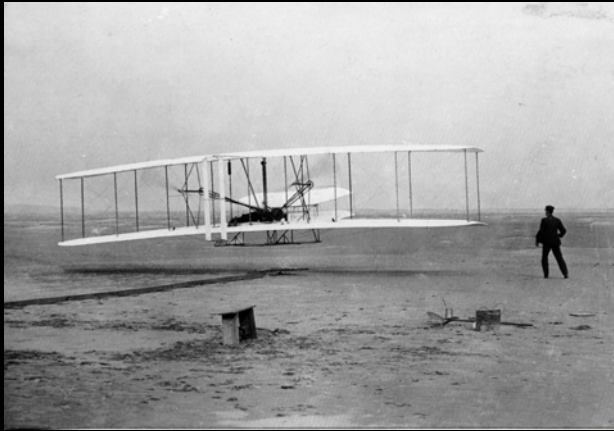
Energy Security

Enabling energy security: sustainable nuclear and economic renewables

Predicting impacts of climate change on environment & infrastructure

Answer 2: We love science and technology because it is stunning in its advances

1903



2006

Thierry Legault

If they could see us now...



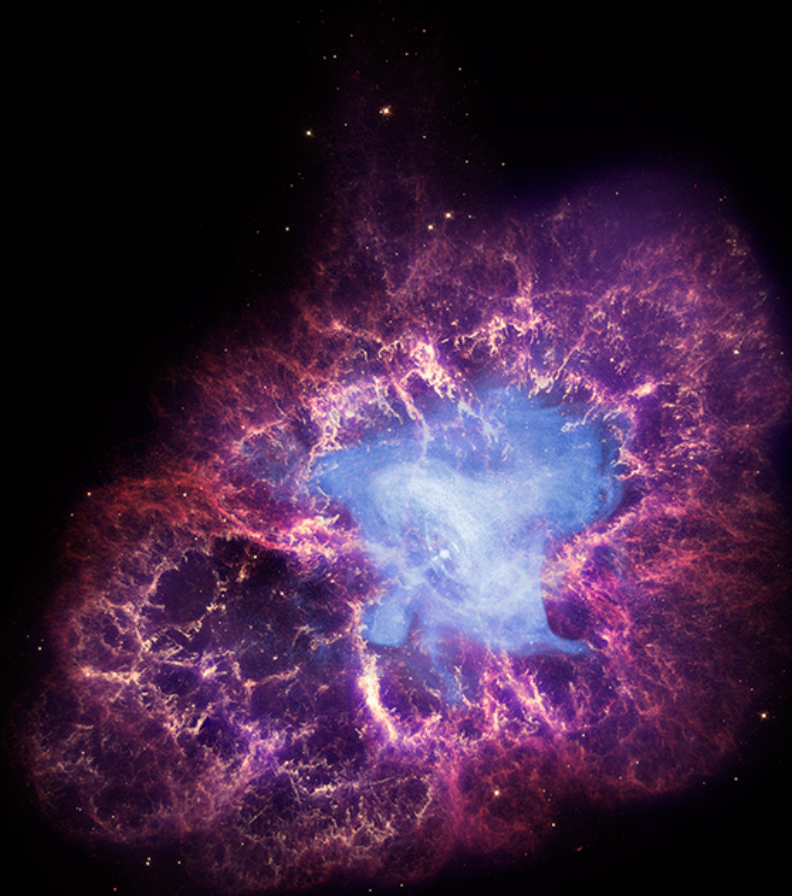
William Reid Ponton, 1898-1956
Cpl. Co. A 316th Engineers 1918-1919

Pictures my grandfather could never have seen



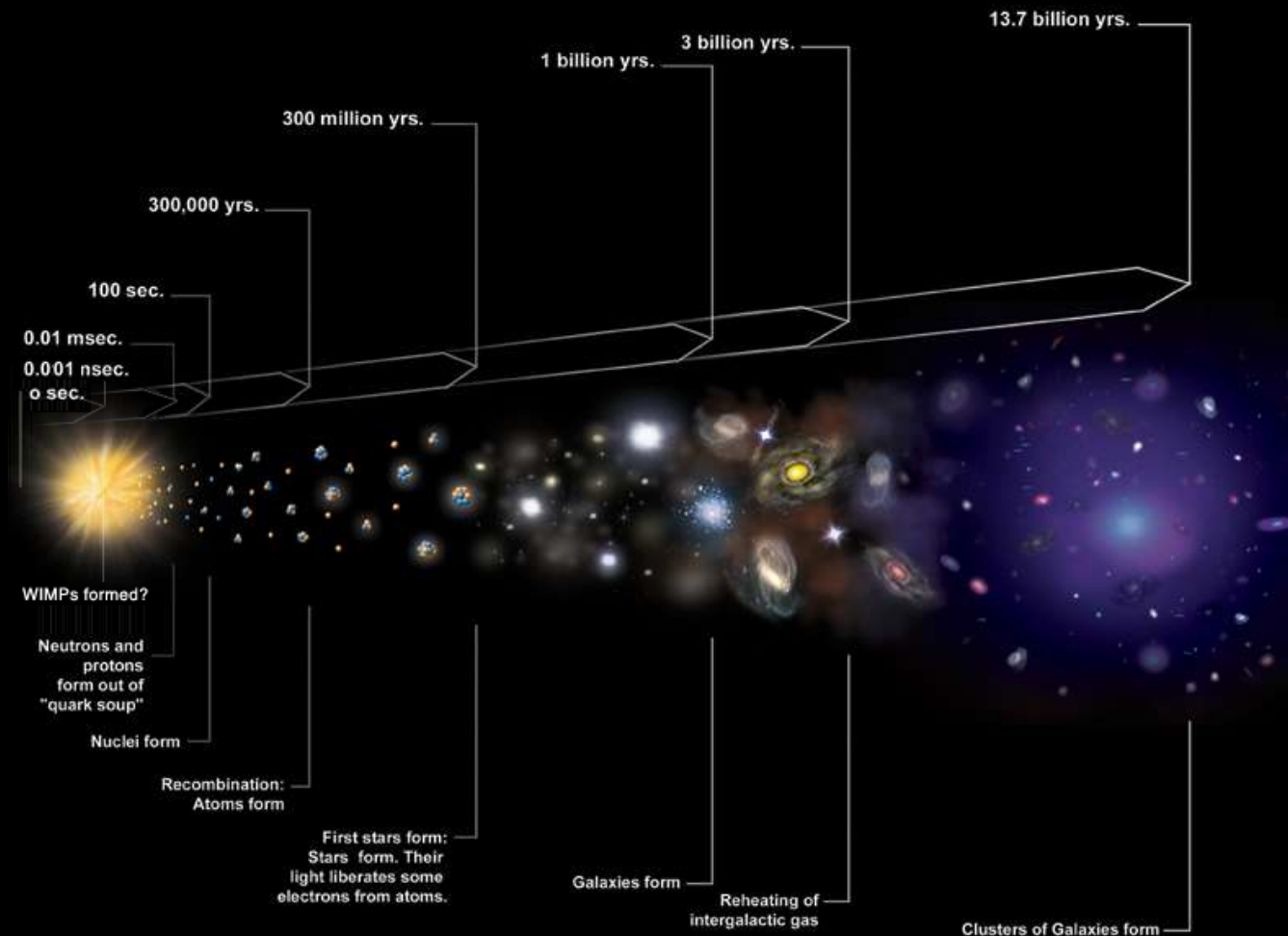
Gas blown out of top of galaxy, distant galaxies in background (Hubble Space Telescope)

Pictures my grandfather could never have seen (continued)



Crab Nebula (remnant of a 1054 A.D. supernova) glowing in X-rays (Chandra)

...Insight into our past that he could never have...



Cosmic timeline from chandra.edu

...an understanding of life that escaped his generation...



*DNA under an electron microscope
(fidelitysystems.com)*

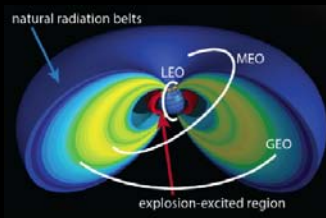
...and views of home that he never had.



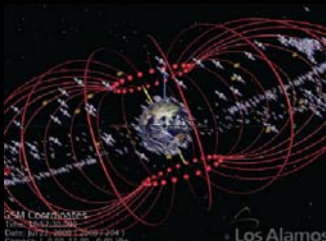
Apollo 8, December 24, 1968

Answer 3: LDRD Research at Los Alamos is best-of-class

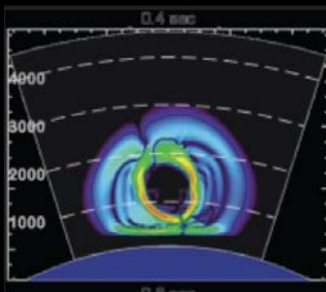
The Dynamic Radiation Environment Assimation Model (DREAM) exemplifies LDRD investment in mission solutions (Poster 26)



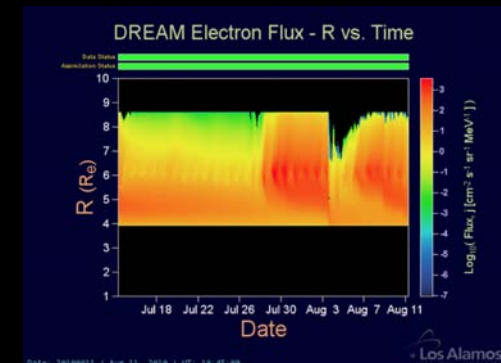
Goal: Accurate specification and forecast of the trapped radiation environment from natural sources and high altitude explosions.



Applications: DREAM uses sparse satellite observations and physical models to determine the global, time-dependent space environment.



National Security: Threat assessment – natural effects versus hostile action. Improved reliability for future space system design. Understanding false triggers and instrument backgrounds.



The DREAM system is functional in beta version, using real-time data from NOAA GOES satellites.

LDRD Research at Los Alamos is best-of-class

Environmental Remediation at Rocky Flats (Poster 33)

LDRD investment in the science behind utilizing x-ray absorption to determine the chemical form of plutonium helped control the transport of plutonium during DOE's biggest cleanup.

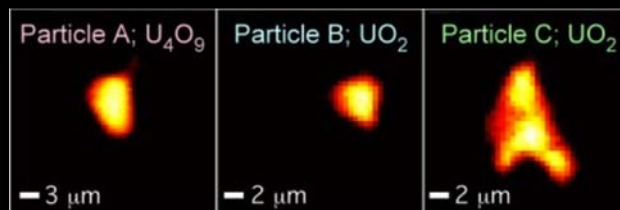


In 1995, cleanup costs were estimated at \$36 billion, with 70 years to complete.

The closure was completed in 2005 with a final cost of \$7 billion.



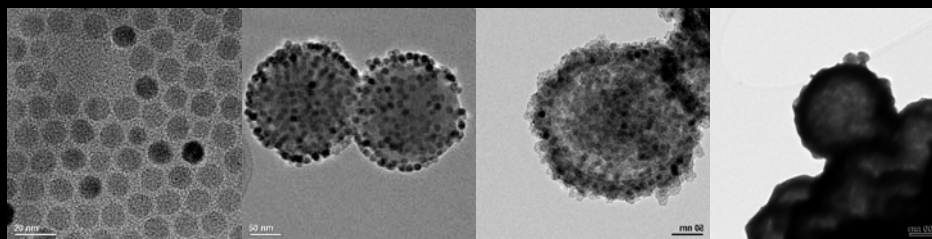
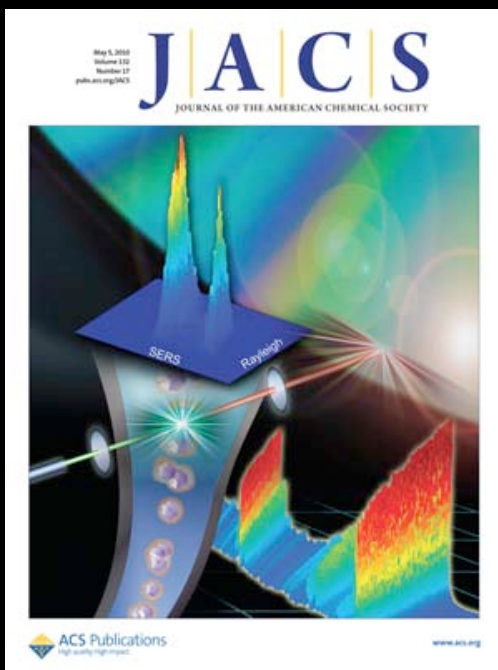
A current LDRD project is enabling us to analyze individual particles through synchrotron micro-spectroscopy.



New LDRD Technology allows us to understand the chemical state of individual microscopic grains.

LDRD Research at Los Alamos is best-of-class

Nanoparticles and Sensing Applications (Poster 24)



- The ability to detect and identify extremely small quantities has grown ever more important in this age of modern chemical and biological weapons
- Using nanomaterials, we will push the current state of the art in detection methodologies towards the ultimate detection limit of a single molecule

LDRD Research at Los Alamos is best-of-class

Engineering innovation for smarter wind turbines (Poster 1)



- Wind resources are abundant, but twice as expensive as electricity generated by burning coal
- Modern wind turbines incur high failure rates because they are not designed for real-world conditions
- LDRD invests in world class engineering to tackle problems with the design and operation of modern wind turbines

LDRD Research at Los Alamos is best-of-class

Using science to battle influenza epidemics (Poster 30)

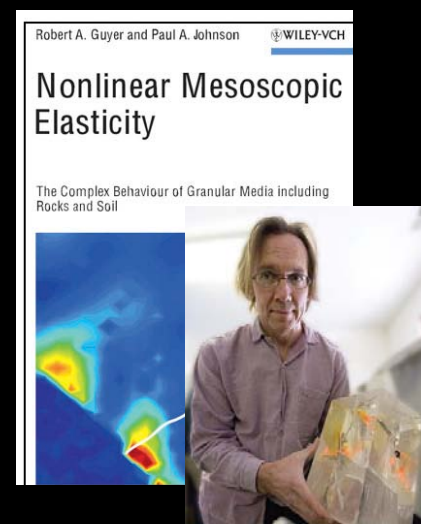
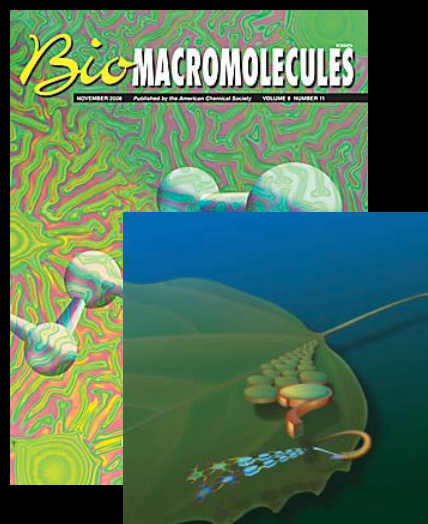
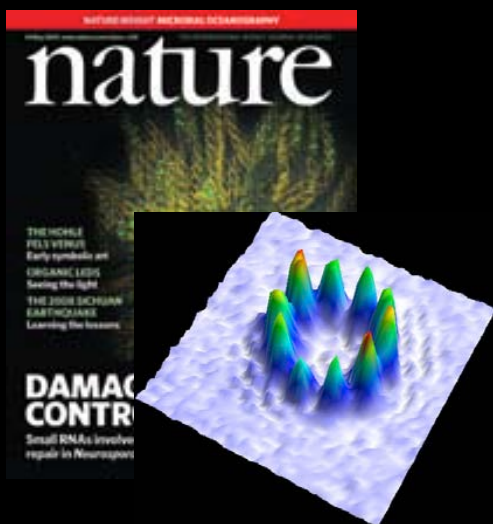


- Each year, ~36,000 people die as a result of influenza infection
- Modeling disease outbreaks requires sophisticated tools
- LDRD researchers are developing a global, multi-scale, mathematical model to track humans **and** the virus
- This research will save money on costly influenza vaccines and antiviral drugs

LDRD FY09 Technical Impacts

Publications strong and holding (2009 data)

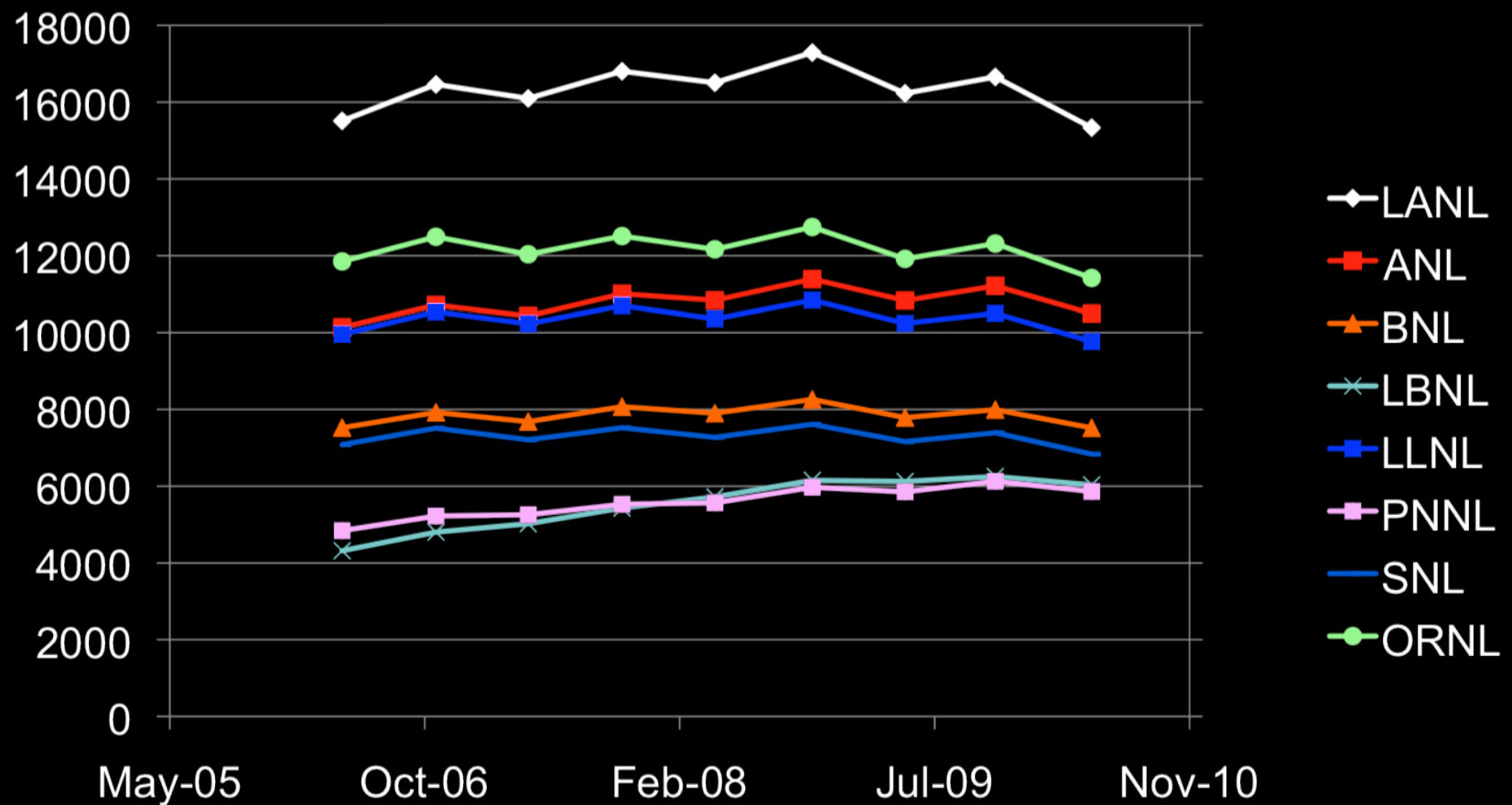
LANL refereed publications	LDRD-supported publications	% due to LDRD
1780	427	24%



(Poster 8)

(Poster 32)

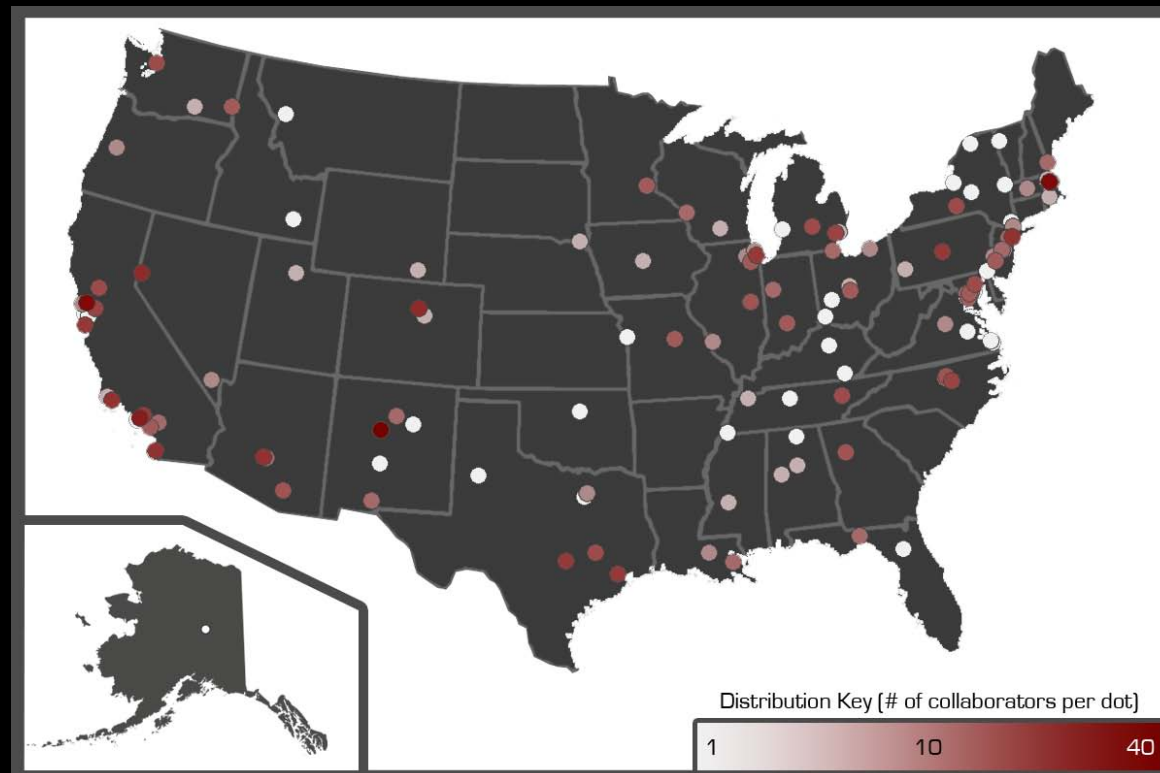
Institute for Scientific Information All Fields Papers Published May 2006 – May 2010



LDRD Reaches Nation-wide and Beyond

Collaborations

LDRD collaborations create strong relationships that are valuable to the Laboratory's pipeline for recruiting scientific and engineering personnel



Components of Excellence (coda)



- ✓ Economically critical
- ✓ Draws one's passion
- ✓ World-class

